



Klamath Network Landbird Monitoring Protocol

Natural Resource Report NPS/KLMN/NRR—2010/187



ON THE COVER

Winter Wren (*Troglodytes troglodytes*)

Photograph by: Jim Livaudais©

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Change History

Previous Version	Revision Date	Author	Changes Made	Reason for Change	New Version

It will be necessary to periodically revise both the protocol narrative and associated SOPs. Documentation of revisions is critical to identify consistency or changes in data collection and management procedures. The format of a protocol narrative complemented by SOPs simplifies the revision process. Because the narrative is a general overview of the planning, sampling, and data management methodologies, it will only require revisions if large changes are made to the SOPs. The SOPs, in contrast, are very specific and may require more frequent minor revisions. Instructions for making protocol revisions are in SOP #18: Revising the Protocol. A revision log is included on the cover page of this narrative and at the beginning of each SOP to track what changes were made and why. In addition, SOP revisions will require updating of the version numbers and the names of each document that was changed.

1. Background and Objectives

This protocol narrative outlines the rationale, sampling design, and methods for monitoring landbirds in the Klamath Inventory and Monitoring Network (KLMN or the Network) of the National Park Service (NPS). It has been prepared in accordance with NPS guidance and standards (Oakley et al. 2003, Mohren 2007, and Sarr et al. 2007). The KLMN includes Crater Lake National Park (CRLA), Lassen Volcanic National Park (LAVO), Lava Beds National Monument (LBE), Oregon Caves National Monument (ORCA), Redwood National and State Parks (RNSP), and Whiskeytown National Recreation Area (WHIS), hereafter known collectively as the parks. The parks, located in southern Oregon and northern California, extend across a broad range of topography, elevation, and corresponding climate and vegetation. This region is recognized for its rich biodiversity, which is represented by a diverse bird fauna (Trail et al. 1997, DellaSala et al. 1999).

1.1 Landbird Monitoring Rationale

The overall purpose of natural resource monitoring in national parks is to develop scientifically sound information on the current status and long-term trends in the composition, structure, and function of park ecosystems. Use of monitoring information will increase confidence in managers' decisions, improving their ability to manage park resources. This increased knowledge will allow managers to confront and mitigate threats to the park and operate more effectively in legal and political arenas. Very few landbird projects have been completed within the parks of the KLMN and there have been even fewer long-term monitoring projects. Without this information, park managers will have difficulty determining the status and trends of these species within their boundaries, they will not have statistically vigorous data available to compare landbird communities within their boundaries to those communities outside their boundaries, and they will not have a clear understanding of how the management practices in the park are affecting landbirds. This protocol will provide park managers with data and information that can be utilized to help better address these issues.

Birds were among the 10 highest ranked vital signs in the KLMN vital signs selection process (Odion et al. 2005). Selection of landbird communities is consistent with the consensus to monitor the status and trends in structure, function, and composition of focal communities, the second highest ranking monitoring question for the Network (Sarr et al. 2007). Landbirds were selected as a focus group for bird monitoring in the KLMN because they provide cost-effective information about ecological conditions of interest (Alexander et al. 2007) and they are well represented in the major terrestrial habitats in the parks. In addition, the status and trends of other bird populations not monitored by this protocol (e.g., sea bird colonies, Bald Eagles, Peregrine Falcons, Northern Spotted Owls) are already being monitored by the parks or by other agencies.

One approach to designing monitoring projects is to focus on groups of organisms that can provide cost-effective information about ecological conditions of interest (Vos et al. 2000, Gram et al. 2001). Landbirds are an effective tool for monitoring because: (1) many species are easily and inexpensively detected, (2) standardized sampling protocols have already been developed, (3) landbird species respond to a wide variety of habitat conditions, and (4) measuring status and trends for many species with different ecological requirements can inform landscape scale conservation strategies (Hutto 1998). The potential for landbirds to serve as effective ecological

indicators is noted in *Recommended Methods for Inventorying and Monitoring Landbirds in National Parks* (Fancy and Sauer 2000). In this publication, Fancy and Sauer put forth the justification for monitoring bird communities within the National Park Service Inventory and Monitoring (I&M) Program:

Birds are an important component of park ecosystems, and their high body temperature, rapid metabolism, and high ecological position in most food webs make them a good indicator of the effects of local and regional changes in ecosystems. Moreover, birds have a tremendous following among the public, and many parks provide information on the status and trends of birds in the park through their interpretive program.

1.2 Landbird Monitoring History in KLMN Parks

The KLMN, working with the Klamath Bird Observatory (KBO), implemented landbird inventory projects in each of the parks using multiple survey methodologies, including those set forth in this protocol. In 2002 and 2003, KBO, in conjunction with U.S. Forest Service Redwood Sciences Laboratory, completed this inventory effort (Sarr et al. *in review*). Prior to this effort, the Point Reyes Bird Observatory (PRBO) implemented two inventory projects at LAVO that examined landbird communities (King et al. 2001, Humple et al. 2001). Results of these inventory studies provided baseline information of bird abundance, and at some parks, additional information such as habitat associations, response to fuels management, and nesting success of focal species. Beyond these inventory efforts, KBO has been operating a mist netting station during breeding and migration seasons at ORCA since 2002, to monitor bird population trends and demographic factors at that park. In addition, the NPS has been monitoring bird population trends and demographic factors at a mist netting station in LAVO since 1997.

As part of the 12 Basic Inventories outlined by the Inventory and Monitoring Program, data from these efforts, along with historical records and data from previous and current park monitoring projects, were used in the recent compilation of a certified bird species lists for each park (Appendix D). A description of this inventory and the species list for each park is located in NPSpecies (<http://science.nature.nps.gov/im/apps/npspp/>). Results from these projects have informed the development of this protocol (Appendices A-D, F).

1.3 Links to Partners in Flight

The KLMN landbird monitoring effort is designed to contribute to monitoring objectives and goals associated with the Partners in Flight (PIF) landbird conservation initiative and PIF bird conservation plans (Table 1). Through implementing the NPS mission to preserve natural resources unimpaired for future generations, KLMN parks are meeting regional and continental PIF habitat-based bird conservation objectives (e.g., protecting high quality riparian habitat and protecting existing alpine habitat from anthropogenic disturbance) (Altman 1999, 2000, CalPIF 2002a, 2002b, 2004, 2005, RHJV 2004, Rich et al. 2004). Data collected through bird monitoring efforts in the parks will provide insight into the relative contribution that the parks make towards PIF's objectives.

Of the bird species identified as conservation focal species or species of conservation concern in the Klamath region by Partners in Flight (Altman 1999, 2000, CalPIF 2002a, 2002b, 2004, 2005, RHJV 2004) and/or by the states of Oregon and California (CDFG 2005, ODFW 2005), 85

species (58%) were among the 146 species detected during the recent landbird inventory of the parks (Appendix A). Within the KLMN monitoring program, landbirds will serve as indicators of ecological condition and landbird monitoring efforts will provide information about the status and trends of these conservation focal species and/or species of conservation concern within the parks.

Monitoring landbirds in the Klamath Network will provide important information about avian community composition in the parks and long-term population trends of specific species. Long-term patterns will help illuminate regional and continental bird population trends. While this monitoring program is not designed to assess the effects of specific habitat changes, it will provide insights into the relationships between land management activities and bird communities. Over time, landbird monitoring will also provide opportunistic information about the effects of natural disturbances and global warming in the parks.

Bird monitoring in the parks will provide a unique dataset in the Klamath region because the parks represent relatively protected landscapes compared to adjacent lands. Landbird monitoring in the KLMN parks will therefore provide insight into the relative contribution that the parks make towards regional and national bird conservation objectives. In addition, data collected through bird monitoring efforts in the parks will inform future revisions of the PIF conservation plans.

The NPS is an active participant in the Partners in Flight international bird conservation program. Through the integration of birds as vital signs within the Inventory and Monitoring Program (Fancy and Sauer 2000, Sarr et al. *in review*), the National Park Service is contributing to national bird monitoring goals that include integrating bird monitoring with management and conservation practices and organizations across spatial scales (US NABCI 2007). Thus, the NPS is meeting obligations to implement the Migratory Bird Treaty Act (Clinton 2001).

Table 1. Partners in Flight conservation plans and California and Oregon conservation strategies that apply to parks within the Klamath Network.

	Klamath Network Parks					
	CRLA	ORCA	LABE	LAVO	RNSP	WHIS
Partners in Flight Conservation Plans						
Continental PIF Intermountain West ¹	X		X	X		X
Continental PIF Pacific ¹		X			X	X
Cal PIF Riparian ²				X	X	X
Cal PIF Oak Woodland ³					X	X
Cal PIF Coniferous ⁴			X	X	X	X
CAL PIF Coastal Scrub ⁵					X	
Cal PIF Sagebrush ⁶			X			
OR / WA PIF Coniferous ⁷	X	X				
OR / WA PIF East-Slope ⁸	X					
California and Oregon Conservation Strategies						
CDFG Wildlife Action Plan ⁹			X	X	X	X
ODFW Conservation Strategy West Cascades ¹⁰	X					
ODFW Conservation Strategy Klamath Mountains ¹⁰		X				
ODFW Conservation Strategy East Cascades ¹⁰	X					

¹Rich et al. 2004, ²RHJV 2004, ³CalPIF 2002b, ⁴CalPIF 2002a, ⁵CalPIF 2004, ⁶CalPIF 2005, ⁷Altman 1999, ⁸Altman 2000, ⁹CDFG 2005, ¹⁰ODFW 2005

1.4 Contributing to Regional and National Efforts

In addition to providing information about landbirds at each park, the KLMN landbird monitoring effort will contribute to and benefit from regional and continental bird monitoring programs. For over 15 years, The Klamath Bird Observatory and U.S. Forest Service Redwood Sciences Laboratory have been coordinating a bird monitoring partnership in the Klamath-Siskiyou Bioregion. Known as the Klamath Bird Monitoring Network (KBMN), this effort has yielded a substantial regional dataset with information about landbird distribution, population trends, and population demographics (Alexander et al. 2004). This monitoring effort also fits within continental monitoring programs, including the Landbird Monitoring Network of the Americas (www.klamathbird.org/lamna/) (Alexander and Ralph 2005) and Monitoring Avian Productivity and Survivorship (DeSante et al. 2004). Data will be contributed to these programs through the Klamath Bird Observatory/Redwood Sciences Laboratory Avian Data Center. Implementing the KLMN landbird monitoring effort within the range of these and other bird monitoring programs (e.g., the Breeding Bird Survey [Sauer et al. 2005] and the Christmas Bird Count [National Audubon Society 2007]) and using comparable sampling methods will provide an opportunity to interpret results at multiple scales that are directly relevant to landbird status and trends. Regional and continental scale assessments can provide insights into the broad scale movements and seasonal habitat requirements of landbirds, which will provide context for interpreting park-specific monitoring results.

1.5 Vital Signs Objectives

As described in the KLMN Vital Signs Monitoring Plan, it is not the intent of the KLMN to develop protocols that are designed to be stand alone projects. It is our intent to show that relationships between status and trend patterns can be observed between protocols providing us with a better understanding of the dynamic nature and condition of our park ecosystems (Sarr et al. 2007). In order to meet this goal, the KLMN has selected landbird monitoring locations to be co-located with monitoring locations from our Vegetation (six parks) (Odion et al. *in development*) and Water Quality and Aquatic Communities (one park) monitoring projects (Dinger et al. *in development*). While co-located sites vary by park, it is our goal to be able to examine trend data from the landbird project and compare that to trend data from the other protocols to help us determine some potential driving forces that are causing the landbird trends. As an example, the sampling design for the vegetation protocol is probabilistic and represents all park habitats (Sarr et al. 2007); the data may be useful for modeling of landbird habitat relations. In addition to these protocols, severe alterations of habitat types will be documented in the KLMN Land Cover Protocol, which may help explain trends in landbird assemblages or individual species. The KLMN plans to develop a Comprehensive Synthesis Report that integrates information from multiple vital signs after the completion of three to five sampling cycles for each protocol (Sarr et al. 2007).

1.6 Management Objectives

In 2003, the Klamath Network began a three phase process for developing a long-term monitoring program. As part of this process, KLMN held a series of scoping meetings and went through a two-step prioritization process that allowed selection of prioritized vital signs to monitor. This process required a broad multi-taxa, multi-ecosystem perspective and careful scientific review. The two steps to prioritize vital signs included: 1) an extensive review with outside scientists in the region, and 2) a final internal review by park and network natural

resources staff. During this process, park resource staff proposed several monitoring questions or topics related to landbirds that they would like this protocol to address. These questions included 1) What are the long-term trends in abundance and distribution of focal and non-native species and communities; 2) What are the demographic trends (especially productivity) of focal species/communities; and 3) What are the status and trends in structure, function, and composition of focal communities. Based on these questions, the Network developed the following objectives to inform park management:

1. Track status and trend information to help managers determine if landbird species are increasing, decreasing, or remaining stable.
2. Present landbird data that will allow managers to determine if landbird assemblages are changing over time.
3. Collect data in a manner that they can be integrated with other regional and national datasets so managers can determine if landbird species/communities are behaving similarly inside and outside their parks.
4. Provide information and outreach materials that can be used by interpretive staff to educate the public about landbirds at each park.

1.7 Measurable Landbird Monitoring Objectives

This monitoring protocol was designed at the individual park scale to inform park managers of changes in composition, distribution, and abundance of landbirds and landbird assemblages. This protocol is designed to meet three measurable objectives further detailed with specific goals that directly relate to park information needs and management:

1. Monitor breeding landbird richness, relative abundance, and density.
 - Determine the status of breeding landbird richness and relative abundance every 3 years within the sampling frame of each park.
 - Provide quantitative information about the distribution and composition of landbird assemblages within 3 years.
 - Determine long-term trends of species richness, relative abundance, and density for abundant breeding landbirds at year 15 and repeated periodically in future years.
 - Provide long-term trends in similarity of landbird assemblages within the sampling frame at each park by year 15 and repeated periodically in future years.
2. Co-sample habitat parameters and integrate bird and vegetation monitoring to aid in interpretation of landbird status and trends.
 - Co-sample habitat parameters every 3 years to provide information about potential causes of landbird trends.
 - Integrate landbird and vegetation monitoring data to aid in the development of the KLMN Comprehensive Synthesis Report.
3. Determine status and trends in demographic parameters (productivity, adult survival, and recruitment) for selected landbird species in a mixed-conifer and riparian habitat at ORCA.
 - Determine the breeding status of landbirds annually.
 - Determine long-term trends of relative abundance, productivity, survival, recruitment, and fitness in abundant breeding landbirds.

2. Sampling Design

2.1 Rationale for Selecting this Sampling Design

This monitoring protocol incorporates multiple standard avian sampling methods (Ralph et al. 1993). These include variable circular plot point counts, area search surveys, mist netting, species checklists, and habitat surveys. All of these methods gather information about multiple bird species with varying life histories. Using complementary methods within the parks will optimize the amount of information gathered about birds. The application of methods also varies by park to complement historic monitoring efforts and to reflect the diversity in park sizes. These approaches are cost-effective, feasible, and yield rich avifaunal information.

During the breeding season (early May through mid July), point count stations will be sampled using 5-minute count periods following the variable circular plot (VCP) methodology that incorporates distance sampling (Reynolds et al. 1980, Fancy 1997, Nelson and Fancy 1999). The VCP methodology has become the standard for spatially extensive sampling under the NPS I&M Program (Fancy and Sauer 2000) because distance sampling facilitates the estimation of detection probability, a parameter that may vary greatly by species, habitat, observer, or other factors (Buckland et al. 2001). Estimates of detection probability in turn permit the estimation of absolute density or relative abundance of birds across the landscape.

The variable circular plot sampling design balances tradeoffs among spatial and temporal sampling intensity, efficiency, funding, and safety. The sampling design is integrated with the design being developed for the KLMN Vegetation Monitoring Protocol, which will provide detailed habitat information at landbird monitoring locations (Sarr et al. 2007). In all parks, point count routes will be established around one or more KLMN vegetation monitoring stations. In addition, sampling frames selected for this protocol match sampling frames developed for the Vegetation Monitoring Protocol. Co-location of these protocols will allow for direct comparison of changes in bird communities and vegetation communities over time.

We evaluated a long-term point count dataset provided by Klamath Bird Observatory from a landscape in the Klamath region to inform sampling design decisions regarding the appropriate number of stations per route and the number of routes required to make defensible estimates of status and trends for common species and select species of concern (Appendix E). Results suggest the minimum number of survey routes for a target population in a park in a specific year is approximately 25. The number of stations per route should not be less than 10, in order to observe enough birds to make inferences (15 or more stations would be optimal). In addition, working with Montana State University, we developed several models based on pilot study and Breeding Bird Survey data to investigate the number of routes and years of sampling needed to achieve 80% power to detect a 50% decline in relative abundance of individual species. Results suggest that using 25-35 routes, with 6-12 points per route, will give us enough power to detect trends within 15 years for those species with little site-by-year variance. Species that are more variable from year-to-year will take longer (30+ years) to determine trends (Appendix J). During the PRBO inventory efforts at LAVO, 13 different habitat types were examined and the number of points needed to detect 100% of the species ranged from approximately seven (Dry Meadow) to 48 (Red Fir). For wet meadow habitats, similar to the habitat type that will be monitored

within this protocol, 10.95 points were necessary to detect 80% of the species in wet meadow habitats and 18.94 points were needed to detect 100% of the species (Humple et al. 2001).

We used the results from the power analyses to inform how many stations would be included along a route, but ultimately our decision was heavily dependent on logistics as well. All stations on a route must be sampled in a given morning, and typically it is not possible to complete more than 12 stations in a survey morning. Based on logistics and the finding above that 11 stations was the lower threshold in both analyses, 12 stations were selected as the benchmark for this study design. It is recognized that a variety of factors (habitat type, travel time, etc.) can further limit the number of points along a route and in challenging terrain the number of points per route may be as low as six.

The stations are placed 250 m apart, which nearly eliminates the likelihood of double counting birds (Scott et al. 1981). Since routes are spatially balanced across the sampling frame and spatial coordinates and distances among sample points will be known, the effects of spatial autocorrelation can be determined explicitly in subsequent data analyses (Legendre et al. 2002). The analysis unit (i.e., whether the stations within a route will be grouped) will vary by analysis depending on the stated objective. For example, after correcting for spatial autocorrelation, individual point count stations can be used independently for analyses that correlate with vegetation characteristics or can be grouped to reduce variance in analyses for improved trend detection.

With the exception of ORCA, 25 to 35 routes will be located in each park depending on the complexity of its landbird sampling frame. In refining the sampling frame in which survey routes are randomly placed for each park, we solicited recommendations from park specialists and evaluated the landbird inventory data and Partners in Flight focal species that would be well monitored in each area of interest. This informed which sampling frame best met the needs of each park under the budget constraints. It is our goal to determine status and trends at the park scale so sampling frames that may vary between parks was not considered an issue.

A constant effort monitoring station, which includes mist netting and banding birds, was established as the best method to monitor birds within ORCA, due to its small size. Constant effort mist netting provides information on bird abundance between years and yields long-term population trend information during both the breeding and migration seasons. It provides information on population demographic measures, such as productivity and estimates of survivorship for breeding populations of landbirds (DeSante et al. 2004). In addition to monitoring breeding birds, mist netting monitors patterns of abundance and population trends for species occurring in the park during the post-breeding and migration seasons, which contributes to greater understanding of the population demographics of a broader suite of species. Operation of an ongoing constant effort monitoring station following standard protocols (Ralph et al. 2004) will continue at ORCA during the breeding season (early May through early August) as well as during the fall dispersal and migration seasons (mid August through mid October). Mist netting, along with VCP point counts, area searches, species checklists, and habitat surveys, will be completed at this station. This more intensive methodology is particularly suitable for a small park such as ORCA (196 hectares [484 acres]). In addition to the mist netting effort, four VCP point count routes will be completed at ORCA following the methods described above.

Threats to landbirds act on multiple scales, as is evident when considering the primary conservation issues for birds in the PIF Pacific Avifaunal Biome, which include loss and fragmentation of habitat and impacts of fire suppression, prescribed fire, recreation, urban and residential development, contamination of freshwater wetlands, and exotic species (Rich et al. 2004). This monitoring plan focuses on the park scale (i.e., within parks) to inform park managers of changes in composition, distribution, and abundance due to natural or anthropogenic habitat changes, including effects of climate change.

2.2 Site Selection

Sampling Frames: The sampling frame and corresponding populations being sampled were selected based on a variety of criteria. Recognizing park needs and logistical, safety, statistical, and funding constraints, we limited the sampling frame based on four criteria. First, route starting points must be greater than 100 m and less than 1000 m from a road or trail (except at WHIS). Our parks are small to medium in size and the road and trail networks bisect the major environmental gradients in the parks. Consequently, the sampling frames are broadly representative of the parks. Next, both for safety concerns and to avoid damage to understory vegetation, we excluded areas having a slope in excess of 30 degrees, talus slopes, and lava flows (Sarr et al. 2007). In an effort to integrate the data collected as part of the KLMN Vegetation and Aquatic Monitoring Protocols, routes must co-locate with sites selected as part of the vegetation and water quality monitoring efforts when applicable. Finally, sampling frames were selected to include as many Oregon/Washington Partners in Flight (PIF) focal bird species, continental PIF bird species of concern, Oregon Department of Fish and Wildlife (ODFW) conservation strategy bird species, and California conservation strategy bird species as possible.

The sampling frames for the parks average between 40% and 63% of the total area and cover a comparable range in biophysical conditions (Sarr et al. 2007). Although not every area and potential vegetation type in the parks will likely be sampled, the sampling frames are consistent with KLMN vegetation monitoring objectives in that they do not introduce a systematic bias in the environments sampled.

Three potential sampling frames were further delineated and considered for sampling in each park, as appropriate. These delineations included high elevation areas (only in CRLA, LAVO, and WHIS), riparian areas (perennial streams, lakes, ponds, and springs), and matrix areas (everything that was not captured in the high elevation or riparian sampling frames). Figure 1 provides an example of the potential sampling frames for Crater Lake. Finally, we examined our ability to detect PIF Focal Species and Species of Concern and ODFW and California Wildlife Conservation Strategy Species, logistic constraints, safety issues, budgetary constraints, and priorities developed by park specialists to determine which of the three frames to survey within each park.

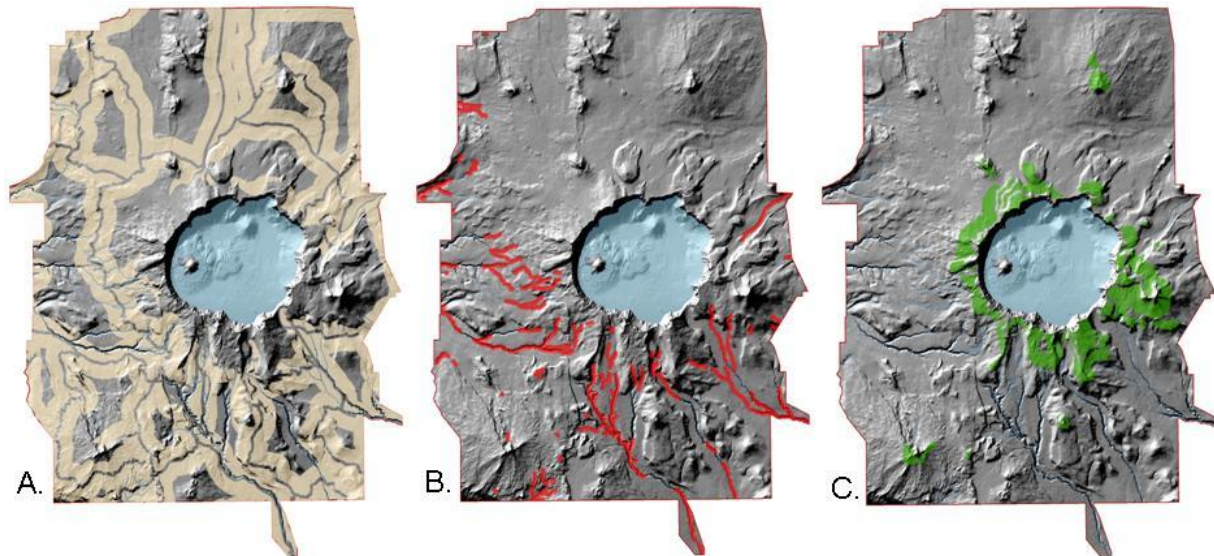


Figure 1. Potential sampling frames for CRLA. We selected one to two sampling frames for each park, which may include (A) Matrix, (B) Riparian, or (C) High Elevation areas.

At CRLA, we excluded riparian areas and established monitoring stations in the matrix and high elevation sampling frames (Figure 1 A and C). Based on the bird inventory conducted in 2002-2003, riparian species were not among the top 15 most abundant bird species in the park. In addition, riparian vegetation only occupies a small area around most of the streams in CRLA. Inventories in 2002-2003 show 10 OR/WA PIF Focal Species, eight Continental PIF Species of Concern, and two ODFW Conservation Strategy Species were detected in the matrix and high elevation areas. The high elevation sampling frame (>6750 ft) was deemed a high priority habitat by the park staff because of the whitebark pine habitat that occurs in this area.

For ORCA and LABE, the sampling frame includes the entire park. ORCA is a small park and we felt that by implementing a few VCP point count routes and the constant effort monitoring station, we could gain information on density and richness as well as demographic information. LABE does not contain any water or high elevation areas; therefore, the matrix area covers the entire park. We examined sampling at cave entrances but determined that these areas would not contain markedly different bird communities.

At LAVO, the sampling frame is limited to riparian populations. We excluded high elevation areas (>8000 ft) due to logistical constraints. Based on previous inventories, matrix and riparian areas were found to contain 11 PIF California coniferous focal or riparian focal species (Humble et al. 2001, Burnett and King 2004). The riparian sampling frame was chosen over the matrix frame because riparian and wetland habitat is very widespread in the park and park staff consider these aquatic environments and edges to host the majority of the park's biological diversity (Sarr et al. 2007).

The matrix frame was selected for monitoring at RNSP, which lacks high elevation areas. The riparian areas at RNSP only contain four PIF riparian focal species and logistical constraints (e.g., steep slopes, downed logs, thick vegetation impeding access, and stream noise) were considered prohibitive for sampling. The matrix areas contain 11 PIF focal species, eight Continental PIF Species of Concern, and two ODFW Conservation Strategy Species.

At WHIS, the matrix and high elevation frames were originally selected for sampling. WHIS has a small amount of high elevation (>5000 ft) habitat that was considered a priority by park staff. Riparian areas contain only three PIF riparian focal species. The matrix areas contain 13 PIF focal species in oak and conifer habitats, four Continental PIF Species of Concern, and two California Wildlife Conservation Strategy Species. However, due to safety concerns of park staff related to the ongoing marijuana activity, the sampling frame at WHIS was redefined to all roads and trails, which cover the majority of the park and allow us to sample the matrix areas throughout the elevation range of the park.

Population Being Sampled: The population being sampled utilizing the VCP point count method is limited to breeding birds in the above sampling frames that are likely to be sampled using point count methodology. These birds include passerines (songbirds) and near passerines (e.g., hummingbirds, woodpeckers). Mist netting techniques and area search methods implemented at the constant effort monitoring station in ORCA sample the same populations as point counts and, in addition, monitor birds during the dispersal and migration period.

By maintaining comprehensive species checklists while conducting point counts and operating the mist netting station, supplemental presence/absence data on all species encountered during a survey effort are provided. For a list of species likely to be detected using these monitoring methodologies in each park, see Appendices C and D.

Analysis of the population will vary considerably depending on the distribution and abundance of species. Initially, trend analysis will only be meaningful for species composition and for the species with little year-to-year variance while status estimates of relative abundance can be applied to all species. Prior to completing a trend analysis, a power analysis will be conducted, based on data collected as part of this approved protocol, to determine precisely the species on which trend analysis will be completed. In addition, an analysis on species composition of landbird assemblages will be completed in year fifteen. After year fifteen, these analyses will be repeated periodically in future years.

Procedures for Selecting Sampling Locations: For choosing VCP sampling locations, we used a Generalized Random Tessellation Stratified (GRTS) design (Stevens and Olsen 2003, 2004) to develop spatially balanced sampling locations within each selected sampling frame for each park. To establish a systematic random sampling route around each GRTS point, 11 adjacent points are placed 250 m apart, according to a set of rules (Appendix L). These rules ensure that a route is set up as closely around the GRTS sample as possible, using a systematic, random approach within constraints in the sampling frame already defined (Figure 2). For example, in matrix sampling frames the rules enforce that the route forms a block (Figure 2A), whereas along roads and trails sampling frame the routes are linear (Figure 2B). GRTS points and the associated route were ground-truthed for accessibility and safety and unsuitable sites were replaced using previously selected overflow points when necessary. Details for locating and marking VCP field sites are in SOP #4: Locating and Marking Field Sites.

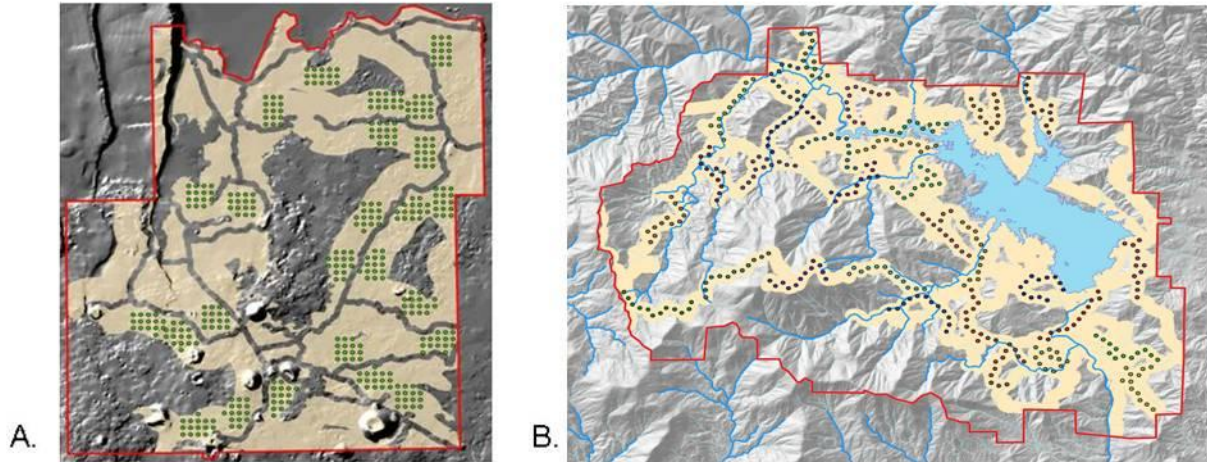


Figure 2. Point count survey routes in the matrix sampling frame at (A) Lava Beds National Monument and (B) Whiskeytown National Recreation Area.

The ORCA constant effort monitoring station is a Sentinel site. Sentinel sites are defined as locations of special interest to sample, or where historical monitoring efforts warrant continuity in sampling. They are selected subjectively on the basis of being representative of a particular habitat or environment of interest and accessibility. The ORCA constant effort monitoring station is characteristic of the mixed-conifer and riparian habitats within the park. In addition, there is a history of bird monitoring activities at the site that the park and the Network would like to continue. For additional details on marking and locating the mist net site, see SOP #4: Locating and Marking Field Sites.

2.3 Sampling Frequency and Replication

To meet the desired spatial sampling regime under budget constraints, VCP point count routes will be surveyed once every 3 years (Appendix E). While it would be ideal to survey each route twice in a given year, funding limitations prevent us from utilizing this method. Two parks will be surveyed each year: RNSP and LABE in year one, LAVO and WHIS in year two, and CRLA and ORCA in year three (Table 2). The constant effort monitoring station at ORCA will be sampled every year (Table 2).

Table 2. The sampling frequency and number of routes and stations to be sampled using VCP point counts and mist netting methods during the first six years of the effort.

Park	Routes/Stations	2008	2009	2010	2011	2012	2013
Crater Lake NP	35 / 420			X			X
Lava Beds NM	25 / 300	X			X		
Lassen Volcanic NP	25 / 300		X			X	
Oregon Caves NM							
Point Counts	4 / 48			X			X
Mist Netting	1 / 10 (nets)	X	X	X	X	X	X
Redwood NSP	30 / 192	X			X		
Whiskeytown NRA	30 / 360		X			X	

VCP routes will be visited one time between early May and mid July every third year. To the degree possible, routes will be sampled approximately the same date in each revisit year. In each

year, sampling will begin with the lower elevation routes in each park; observers will gradually progress upslope throughout the season. This strategy will help ensure monitoring at each site occurs at or near the peak of the breeding season. Surveys will begin during the 15 minutes following local sunrise and be conducted during the following 3-4 hours (SOP #5: Conducting Variable Circular Plot Point Count Surveys).

The number of VCP routes that are established at all parks, besides ORCA, will meet or exceed 25, with 6-12 stations per route (Table 2). Larger parks and more complex sampling frames were allotted additional routes beyond the minimum to increase statistical power. The number of routes per park is: CRLA (n=35), LABE (n=25), LAVO (n=25), ORCA (n=4), RNSP (n=30), and WHIS (n=30).

The constant effort mist netting at ORCA is operated from late-May through mid-October each year. The mist nets are operated within 15 minutes of official sunrise and continuing for 5 consecutive hours, weather permitting. The site is run once in a 10 day period during the breeding season (May - August) and weekly during fall migration (September - October) (SOP #6: Mist Netting).

2.4 Level of Change That Can Be Detected

The number of VCP sampling stations necessary to determine status and trends in breeding bird species richness and density in the parks depends on the frequency of sampling, the quantity and dispersion of birds, and the likelihood of detection. We determined sampling routes to be the appropriate sample unit for monitoring of landbird communities because they provide more robust estimates of the species. Our approach of aggregating samples into routes or clusters of 12 should increase precision of parameter estimates at the route level. With this sampling design, we will be able to detect trends (i.e., 80% power to detect 50% decline over 20 years at a significance level of 0.10 [Bart et al. 2004]) for some of the species that are less variable from year-to-year within 15 years of monitoring. However, species with more year-to-year variability in abundance and density will take longer. An example of this is provided in the power analysis in Appendix J. As the third example provided in memo three shows, the Western Meadowlark at LABE is not highly variable from year-to-year and it would only take 15 years (four visits) of sampling 20 routes with 12 points per route to reach our goal of 80% power to detect 50% decline over 20 years at a significance level of 0.10. However, for species such as the Brown-headed Cowbird that were more variable at LABE from year-to-year, such as is shown in example two of this memo, it may take over 30 years to determine a trend.

To determine and evaluate the efficacy of the constant effort monitoring station at ORCA, we performed a power analyses on five commonly captured species at ORCA. Results indicate there is sufficient power to detect trends for three species following recommendations established by Bart et al. (2004) (i.e., 80% power to detect 50% decline over 20 years at a significance level of 0.10). Data provide sufficient power to detect trends for adult McGillivray's Warblers during breeding season, adult and juvenile Dark-eyed Juncos during the breeding season, and Dark-eyed Junco and Hermit Thrush populations during the post-breeding season (Appendix F). These results suggest that this mist netting site will yield important trend information over time, as well as contribute to the trends detected by larger regional mist net monitoring efforts conducted by the Klamath Bird Observatory.

2.5 Monumenting Bird Monitoring Sites

In 2008 and 2009, KBO working with the KLMN, permanently monumented stations along each of the point count routes we plan on surveying as part of this protocol. Points along the route were monumented in a variety of ways, depending on the park, and included small 1" brass tags with "KLMN" and the point count station number engraved on them or 5"x5" yellow signs with the phrase "This site is part of the long-term landbird monitoring project being conducted by the NPS-Klamath Network Inventory and Monitoring Program" and included the route and site name written using a permanent paint marker. In addition to one of the markers, in some cases flagging was used to help guide the surveyor into the station or to make the station more visible. A GPS coordinate, directions, and site characteristics were recorded for each point along a route (Appendix I).

3. Field Methods

3.1 Schedule

In January of each year, the Project Lead will apply for permits at each park that will be surveyed that year. The Project Lead should also contact the Park Contact to see if housing or camp sites will be available. At that time, the Investigator Annual Reports will be submitted for work completed the year prior.

In order to ensure the data collected using the VCP point count survey techniques described above is accurate, it is important to hire technicians that are skilled in visual and audio bird identification. The mist netting effort at ORCA provides an opportunity to train biologists less skilled with bird identification. Therefore, interns hired to support the mist netting effort do not need the full complement of skills required to conduct the VCP point count surveys. However, it is important to have individuals skilled in conducting mist netting techniques available to help the interns learn about and operate the mist netting station. To ensure skilled biologists are available, hiring of technicians and interns should occur during the winter prior to starting the field season. Upon hiring of field personnel, the Project Lead will mail this protocol to each crew member (SOP #1: Preparation and Equipment). Prior to sending the crews into the field, each crew member should undergo a rigorous training program. For more information on training technicians and interns, see section 6.2 of this narrative and SOP #2: Training Observers.

A schedule, including date ranges for conducting VCP point count surveys in each park, and a delineation of the constant effort monitoring 10-day breeding season and 1-week migration season periods, will be completed by the Project Lead in April, prior to the onset of the survey season. This schedule must allow enough flexibility to account for surveys cancelled due to weather or other unforeseen logistical circumstances. It shall also outline training and testing days. Additional scheduling information can be found in SOP #1: Preparation and Equipment, SOP #10: Post Field Season, and SOP #16: Data Transfer, Storage, and Archiving.

3.2 Variable Circular Plot Point Count Surveys

The details for completing VCP point count surveys are included in SOP #5: Conducting Variable Circular Plot Point Count Surveys. For each point count route, a folder will be compiled to include a map, geographic coordinates for each station, and copies of written descriptions of the route. This information will be duplicated and compiled into an office binder as a record of each route. Prior to the field season training, each surveyor will review this entire protocol, study or review the identification of western birds by sight and sound, and follow other directions for preparing for field work specified in SOP #1: Preparations and Equipment. Surveyors will participate in a 2-day training course that focuses on calibrating distance estimates and assuring proficiency in implementing all aspects of this protocol. Each surveyor will be tested for bird identification, hearing capacity, and ability to follow the protocol before conducting surveys (SOP #2: Training Observers). If an individual does not pass the test, he or she will be given the opportunity to retest after going through additional training.

Crews will go into the field for a 10-20 day sampling trip before returning to the field office to prepare for the next sampling period. Surveyors conducting VCP point count surveys should

arrive at the route's starting location in time to begin surveying before dawn, preferably the afternoon or evening before the count. The stations should be located by using the site description forms, a GPS unit with geographic coordinates, maps and by determining the location of the monumented stations.

The first survey will begin within 15 minutes of sunrise. Before conducting each survey, observers shall use digital rangefinders to establish distance reference points at each station. During a 5-minute count period, all birds detected by sight or sound are identified to species and recorded on data forms, along with the horizontal distance to each bird, estimated as accurately as possible, and rounded to the nearest meter. The time of detection, detection type (e.g., visual, song, call), and breeding status are also recorded for each individual detected.

Once a count is complete, the surveyor walks to the next station for subsequent counts. Point count surveys should be completed within 3-4 hours of sunrise. The corresponding vegetation surveys may be completed the afternoon before the point count survey or on the day of the survey, after the survey has been completed. Before leaving the route, datasheets shall be checked for completeness. Field forms will be stored in a secure location while in the field and turned in at the end of each field trip.

3.3 Constant-Effort Mist Net Monitoring

The details for operating the constant effort monitoring station at ORCA are included in SOP #6: Mist Netting. Equipment and copies of the site description forms for the mist netting site and banding should be prepared prior to the field season as specified in SOP #1: Preparations and Equipment. A visit to the constant effort monitoring station should be scheduled prior to the first survey effort in order to prepare mist net lanes and trails. The preparation for the mist netting field season, training, protocols, and equipment needs are detailed in SOP #1: Preparations and Equipment, SOP #2: Training Observers, and SOP #6: Mist Netting.

The mist netting station consists of 10 nets set in an array to optimize bird capture and meet logistical constraints. Mist nets are opened within 15 minutes of local sunrise and operated for 5 hours. Nets are not operated during inclement weather conditions that might affect capture rates or bird mortality in the nets (e.g., high winds, rain, or extreme cold or heat). Captured birds are identified to species and unbanded birds are banded with a U.S. Geological Survey Bird Banding Laboratory aluminum butt-end leg band. Each bird is then aged and sexed according to Pyle (1997) and checked for signs of breeding condition (i.e., cloacal protuberances and brood patches). Additional biometrics is collected and all data, including band number, are recorded on datasheets. Birds are then released.

3.4 Area Search Surveys

The area search methodology is described in detail in SOP #7: Conducting Area Search Surveys. In conjunction with mist netting, two area search surveys are completed at the constant effort monitoring station on each day the site is operated. The surveys are conducted within the same time period that the mist nets are operated. This method provides information about birds using the site that are not often captured in the nets (e.g., canopy-dwelling warblers). The area search survey is completed within a 20-minute period in which all birds seen or heard in the designated search area are recorded. During an area search, the surveyor moves around the designated area

so they can track down cryptic birds. Multiple observers can conduct area search surveys, providing an excellent opportunity for training.

3.5 Species Checklists

Refer to SOP #9: Completing Species Checklists for details about developing species checklists. Species checklists will be completed in conjunction with point count surveys, area searches, and mist netting. Species checklists provide information on common and rare species that may or may not have been detected using the other survey techniques but were observed at any time during the field day. Surveyors should use the checklist forms to keep a comprehensive list of all birds encountered during their time spent at a survey location (i.e., VCP point count route or constant effort monitoring station). Surveyors should also note the breeding status of each species encountered. The species checklist adds value to survey data by accounting for all species encountered during an effort, whether detected during an actual point count, area search, or mist netting survey.

3.6 Vegetation Surveys

Refer to SOP #8: Conducting Vegetation Surveys for detailed methodology and the field protocol. Vegetation surveys are completed at each point count station and at the constant effort monitoring station. The vegetation relevé is a method of assessing habitat characteristics in an efficient and timely manner. It is flexible so that it can be applied to any habitat type, including shrublands, grasslands, and forests found in the parks. The information collected describes the vegetation composition and structure of the habitat being surveyed and can be used to determine the plant association type. Vegetation data will be gathered using ocular estimates of cover and height for all vegetation layers, tree and shrub species, and other plant forms. Other pertinent variables will be collected, including snag counts, presence of water, evidence of burns, and tree size and height. The data have been designed to account for habitat aspects associated with the feeding and nesting requirement of birds.

In addition to the relevé plots, point count surveys will be co-located with vegetation plots sampled under the KLMN Vegetation Monitoring Protocol (in development). As part of the KLMN Vegetation Monitoring Protocol, the KLMN will sample vegetation at one or more points along each survey route using the Modified-Whittaker plot design. The plots will measure 20 m by 50 m (1000 m²) and contain nested subplots of three different sizes. These plots will provide additional detailed vegetation information that can be used to conduct analysis on co-varying bird and vegetation trends. Vegetation plots will be surveyed in the same year that the landbird routes are surveyed.

3.7 Post Season

Details for closing out the field season can be found in SOP #10: Post Field Season. In general, at the end of the field season, the Field Lead should prepare a brief report to the Project Lead that includes details regarding the field season logistics, interesting observations, and suggestions for future improvements. The Project Lead is responsible for making certain all surveys have been completed, organizing and copying field forms, and assuring site folders are in order for the following season.

4. Data Management

Data management for a monitoring project is a cyclic process that begins during the planning phase of a project and continues until the close-out of the season. This process is then repeated each year the project is implemented and includes data collection and entry, validation and verification processes, documentation, distribution of project products, storage, and archiving (Mohren 2007). This section provides an overview on data handling, analysis, and report development with details on these processes located in the related SOPs. It is important to ensure that project personnel understand all necessary data management methodologies, including who is responsible for implementing the methods and the timelines they are expected to follow when conducting data management. SOP #16: Data Transfer, Storage, and Archive and Appendix G list the target dates and responsibilities for each individual and product. The stages of the data management cycle are described in greater depths later in this narrative and in several associated SOPs, but can be briefly summarized as follows:

Preparation – Training, logistics planning, printing forms and maps

Data acquisition – Field trips to acquire data

Data entry & processing – Data entry and uploads into the working copy of the database, GPS data processing, etc.

Quality review – Validation and verification methods are used to review the data for quality and logical consistency

Metadata – Documentation of the year's data collection and results of the quality review

Data certification – Data are certified as complete for the period of record

Data delivery – Certified data and metadata are delivered for archival and upload to the master project database

Data analysis – Data are summarized and analyzed

Product development – Reports, maps, and other products are developed

Product delivery – Deliver reports and other products for posting and archival

Posting & distribution – Distribute products as planned and/or post to NPS clearinghouses

Archival & records management – Review analog and digital files for retention (or destruction) according to NPS Director's Order 19; rename and store retained files as needed

Season close-out – Review and document needed improvements to project procedures or infrastructure, complete administrative reports, and develop work plans for the coming season (Siegel et al. 2007)

4.1 Preparation

It is the Project Lead's responsibility to create a detailed work plan for each 10-20 day sampling trip prior to sending the technicians into the field. The Project Lead will ensure technicians have all the required gear and the most up-to-date field forms (Survey Forms, Data Entry Log, Photograph Metadata Log, etc.). The Project Lead needs to make certain that site folders are organized and complete (SOP #1: Preparation and Equipment). Each crew member will confirm that they have the site folders for all sites they could potentially visit in the 10-20 day survey period prior to leaving for the field.

It is the Project Lead's responsibility to make certain all field equipment (e.g., laser range finders, GPS units, etc.) are calibrated and properly set up prior to heading into the field (SOP #3: Using the Global Positioning System). The Project Lead will work with each field technician to make certain target locations are loaded into the GPS units. The Project Lead will work with the technicians to make sure it is clear where everyone is going, what is expected to be completed, and timelines for when the work should be finished.

4.2 Data Collection and Entry

Details on how to collect, enter, and verify data can be found in SOP#12: Data Entry and SOP#13: Data Validation and Verification. In general, technicians and interns will record field data on standardized datasheets for each type of survey. Datasheets should be reviewed before leaving the point count route or mist netting site to make certain they are complete. At the end of a 10-20 day sampling trip (for VCP point count surveys) or end of the week (for mist netting), data forms are submitted to the Project Lead. The Project Lead should examine the datasheets for completeness and accuracy prior to the crew going back into the field. At the end of each week, interns will enter the mist net data into the appropriate Access databases (Section 5.3). Technicians should enter point count data into the database at the end of each sampling period, unless prior arrangements have been made with the Project Lead. Data should be entered as soon after surveys as possible to help keep current with data entry tasks and to catch any errors or problems as close to the time of data collection as possible (SOP #12: Data Entry). After entering the data from the datasheet into the computer, each record should be checked for completeness and accuracy before moving on to the next datasheet. A data entry log must be maintained during data entry (SOP #12: Data Entry).

4.3 Overview of Database Design

While collecting data throughout the field season, we will use six relational databases developed by KBO to store the variety of field data that will be collected as part of this protocol. Five of the databases are associated with each survey methodology (Point Count, Mist Net, Vegetation, Area Search, and Checklist) and one of the databases is used to store location information for each site. These databases are consistent with those designed for the Klamath Bird Monitoring Network (KBMN). This will give the KLMN and the KBMN the opportunity to analyze data not only at the park scale, but also at a regional level. Once the data have been entered into the six relational databases, a series of programs will be used to initiate a number of verification processes (SOP #13: Data Validation and Verification). Once this is complete, a copy of the verified, validated, and certified data will be uploaded into a single database managed by the Klamath Network (Appendix H).

The Klamath Network Landbird database is a relational database that was developed using the NPS, Natural Resource Database Template (NRDT) (SOP #16: Data Transfer, Storage, and Archive). A functional comparison of the KLMN Landbird database and the six relational databases used for data entry are included in Table 3. The KLMN database includes an automated process to upload the data from the six KBO databases. During the upload process, a quality control report is developed and issues are addressed as needed. Once all issues are addressed, the data are uploaded to a master database that contains all the data from previous years. The master database is a replicate of the annual database and has all the same features. However, it will include some additional reporting and exporting tools.

Table 3. Functional comparison of the data entry databases and the KLMN Landbird database.

Project database functions and capabilities	6 relational databases for data entry	KLMN Landbird Database
Software platform for back-end data	MS Access	MS Access
Contains full list of sampling locations and taxa		X
Portable for remote data entry	X	X
Forms for entering and editing current year data	X	X
Quality assurance and data validation tools	X	X
Preliminary data summarization capabilities	X	
Full analysis, summarization and export tools		X
Pre-formatted report output		X
Contains certified data for all observation years		X
Limited editing capabilities, edits are logged	X	
Full automated backups and transaction logging		X

4.4 Documentation

Metadata and data dictionaries are completed for each of the six datasets used to enter field data and for the KLMN Landbird database (Appendix H) at the onset of implementing the Landbird Monitoring Protocol. It is the Project Lead's responsibility to update and submit the data dictionary (if needed) and to submit a new Metadata Interview form at the end of each field season. The Metadata Interview form will be submitted each year and will be used to indicate if changes have occurred to the metadata or data dictionary. If changes have occurred, it is the Data Manager's responsibility to archive and update the metadata for each database. Details for metadata development and delivery are described in SOP #14: Metadata Guidelines and SOP #16: Data Transfer, Storage, and Archive.

4.5 Field Forms

Field forms will be submitted to the Project Lead at the end of each 10-20 day sampling trip (for VCP point counts) or at the end of each week or 10-day period (for mist netting), and stored in their proper file cabinet. Once the data have been entered into the relational databases and subjected to all quality control processes, and the datasheets have been corrected, they will be transferred to the Network Data Manager. It is the Data Manager's responsibility to scan the datasheets into several PDF documents following the guidance in SOP #16: Data Transfer, Storage, and Archive.

4.6 Data Verification and Validation

After collecting the field data, but prior to leaving the site, the field technician or interns will review all data forms to make sure they are complete. After the end of the sampling period, the Project Lead will review the datasheets. The technicians or interns will enter the data into the proper databases, where each record will be examined for completeness and to make sure it matches the hardcopy field forms prior to entering the next record. At the end of the season, the Project Lead will compile data from each of the crew member's Access databases and compile the information into one dataset for each survey type (e.g., VCP point count, vegetation). These compiled datasets undergo further proofing, using automated computer programs (run in R, SAS, and Access) that were developed to check the data for completeness and accuracy. These

programs verify station names and survey dates, assuring multiple survey types conducted at stations are in order. The programs also assure the data make biological sense (e.g., confirm that age and sex classes assigned to birds are biologically possible based on date of capture). The process for proofing and editing data is detailed in SOP #13: Data Validation and Verification. Once all validation and verification methods have been implemented, the databases will be transferred to the KLMN Data Manager where they will be uploaded to the KLMN Landbird database. While uploading the data into the database, the data will be subject to automated data quality process that will flag potential missing sites, invalid data, and data in an improper format.

4.7 Backup Process

During the field season, field forms will be submitted to the Project Lead and stored in cabinets at the end of each sampling trip. At the end of the field season, these datasheets will be scanned into PDF documents and stored in the Landbird project folder located on the Klamath Network server. The information stored on this server is subject to the daily, weekly, and quarterly backup process described in the Klamath Network Data Management Plan.

Each day that data are entered into any database, a copy is made and stored on the server at the Project Lead's office. Once the databases are transferred to the KLMN Data Manager, they are loaded into the KLMN Landbird Database. This is stored in the Landbird project folder, which is backed up following the process described in the KLMN Data Management Plan.

Prior to the start of a new field season, all products from the prior field season will be transferred to the Network Contact (SOP #16: Data Transfer, Storage, and Archive). The Network Contact will work with the Data Manager to make certain that products are stored in their proper location on the KLMN server. Once on the server, all products will be subject to nightly, weekly, and quarterly backups as outlined in the Klamath Network Data Management Plan.

4.8 Image Handling Procedures

Images collected to document field sampling, site setup, and species vouchering should be collected in a Joint Photographic Experts Group (JPEG) format at a minimum photographic resolution of four megapixels whenever possible. When submitting images to the Data Manager, an Excel form should be included that provides the metadata for each image. When transferred to the Data Manager, images and corresponding metadata will be stored in the landbird monitoring project folder. It will be the responsibility of the Data Manager to upload these images and metadata to the KLMN Photograph Library for use by the Network staff. Details on image management are provided in SOP #11: Photo Management.

4.9 GPS Data Processes

The location of each mist net and survey station are captured digitally with a Trimble GeoXT GPS unit to document the location of the site. This is the only GPS data that will be collected as part of this protocol. As GPS technology improves, station and net locations may be resurveyed to collect the most accurate locations possible. GPS processes are listed in SOP #3: Using the Global Positioning System. If a crew member cannot find the location of the permanent marker, but based on the site description forms and maps feels he or she is in the correct location, that individual should capture GPS coordinates (and record them on the datasheet) so his or her actual location can be determined at a later date. The Project Lead should look at the new

coordinates and compare them to the previously documented location of the survey point and determine if the field personnel were in the proper location.

4.10 Data Certification

Data certification is a benchmark in the project information management process that indicates: (1) the data are complete for the period of record; (2) they have undergone and passed the quality assurance checks; and (3) they are appropriately documented and in a condition for archiving, posting, and distributing as appropriate. Certification is not intended to imply that the data are completely free of errors or inconsistencies. Rather, it describes a formal and standardized process to track and minimize errors.

To ensure that only quality data are included in reports and other project deliverables, the data certification step is an annual requirement for all data. The Project Lead is primarily responsible for completing the data certification form, available on the KLMN web sites. This brief form should be submitted with the certified data according to the timeline in SOP #16: Data Transfer, Storage, and Archive.

4.11 Product Distribution

It will be the KLMN Data Manager's responsibility to utilize the season's certified raw data along with the materials presented in the annual report, analysis report, data dictionary, and Metadata Interview form to populate or update the NPS I&M databases including NPSpecies, NatureBib, and the NPS Data Store. Details on distribution can be found in SOP #16: Data Transfer, Storage, and Archiving. In general:

- All reports will be posted on the NPS Data Store and KLMN Internet and Intranet web pages.
- The full report will be sent to the Resource Chiefs of each park and to any park staff that are associated with the project.
- A short, one-page summary of the report will be sent to all park staff.
- One record will be created in NatureBib for each annual report, comprehensive report, and third year analysis and synthesis report and linked to the corresponding species in NPSpecies.
- The raw data and reports will be used to determine if any bird species was observed that is not currently recorded in NPSpecies for each park. Observations of previously unrecorded bird species will be updated in NPSpecies following park-specific guidance.
- Metadata for each database will be created and updated based on the Metadata Interview form and data dictionary provided by the Project Lead each year. Metadata for the project database will be posted at the NPS Data Store.
- Photographs and metadata provided for photographs will be stored in the project folder located on the Klamath Network shared drive, where only the Data Manager will have write access but all KLMN employees will have read access.

4.12 Holding Period

To permit sufficient time for priority in publications, when data are sent to the park staff or the public, it will be with the understanding that these data are not to be used for publication without contacting the Network Contact. After each 3-year survey cycle, all certified, non-sensitive data

will be posted to the NPS Data Store. Note that this hold only applies to raw data and not to metadata, reports, or other products that are posted to NPS clearinghouses immediately after being received and processed.

4.13 Sensitive Information

Certain project information related to the specific locations of rare or threatened taxa may meet criteria for protection and as such should not be shared outside NPS, except where a written confidentiality agreement is in place prior to sharing. Before preparing data in any format for sharing outside NPS, including presentations, reports, and publications, the Project Lead should refer to the guidance in SOP #15: Sensitive Data. Certain information that may convey specific locations of sensitive resources may need to be screened or redacted from public versions of products prior to release. All official FOIA requests will be handled according to NPS policy. The NPS Lead will work with the Data Manager and the FOIA representative(s) of the park(s) for which the request applies.

4.14 Data Analysis and Reporting

Working with the park specialist and landbird experts from the Klamath Bird Observatory, we have developed a comprehensive strategy to analyze and report the data and information collected and developed from this protocol over the next 15 years. There will be two elements of reporting for the KLMN landbird monitoring project: (1) an annual summary report and (2) an analysis and synthesis report submitted every third year. These reports are intended to address the objectives of the KLMN landbird monitoring efforts and inform the KLMN annual administrative report and vital signs comprehensive synthesis reports. In addition, the parks' landbird monitoring efforts will be integrated into the Klamath Bird Observatory's comprehensive effort reports that summarize bird monitoring efforts conducted throughout the Klamath-Siskiyou Bioregion. A summary of the various reports are provided below. However, details about individual reports and analyses can be found in SOP #17: Data Analysis and Reporting.

4.15 Annual Reports

The annual reports will provide summaries of monitoring efforts for each sampling year and will be due on March 1 of the following year. The annual report will include: (a) an executive summary; (b) an introduction referencing the protocol; (c) a summary of the current year's monitoring efforts; (d) a summary of past efforts; (e) a summary of bird detections and associated Partners in Flight status; (f) a list of additional birds detected only on species checklists; (g) public interest highlights; (h) a summary of relevant outreach, reports, publications, and presentations; (i) the current year's datasets; and (j) documentation of any changes made to the protocol.

4.16 Analysis and Synthesis Reports

Analysis and synthesis (A&S) reports are being developed in a way that each complements and builds upon previous reports. The first of five analysis and synthesis reports, prepared in 2010, will focus on 3 years of data collected at the VCP point count stations during the 2008-2010 field seasons. The report will contain three related analyses that will inform us about the nature of bird communities in the parks of the Klamath Network, as well as the feasibility and efficiency of our sampling regime. The first analysis will explore detectability and will result in density estimates

by point, route, and park, and spatial patterns of species density using habitat data, and landbird community structure in the parks.

In year six, the second analysis and synthesis report will focus on 10 years of data collected between 2002 and 2012 at the Oregon Caves constant effort monitoring station. We will conduct trend analyses for breeding and migrating species and compare results with trends generated from the area search data collected at the station, as well as trend information generated from Klamath Bird Monitoring Network and Breeding Bird Survey data. Productivity indices generated from the ORCA data will be related to the trends to evaluate the relationships between breeding success and population abundance.

The third analysis and synthesis report, completed in 2016, will consist of a power analysis undertaken with monitoring data from years 2008 to 2016. Through this analysis, we will determine the probability of detecting a 50% decline in breeding season densities of focal species occurring within 20 years at a significance level of 0.10. These trend metrics have been put forth as a standard goal for Partners in Flight coordinated monitoring efforts (Bart et al. 2004). While a power analysis was completed to help design this protocol, the purpose of this report is to redo the power analysis using data collected following this protocol to 1) ensure the methods being used support the conclusions of the prior power analysis, and 2) determine which species we will have sufficient data on to provided trend estimates that will be developed starting with the fifth analysis and synthesis report, and 3) to determine the timeframe that the trend analysis should be repeated after the first 15 years.

The fourth analysis and synthesis report will be completed in 2019. It was determined that data collected during the first 12 years of this effort (four surveys per park) would not provide enough information to conduct an adequate analysis of trends on the landbird community at this point in time. In addition, based on the selected survey methods, we recognize we will be collecting a large variety of data and information that can be analyzed and reported in a multitude of methods. Therefore, we have decided not to designate a specific report or analysis for the 12 year report. Upon completing the third analysis and synthesis report, KLMN and park staff will meet with the Klamath Bird Observatory to examine what we have already learned and what information gaps still need to be filled. At that time, we will determine what report and associated analysis should be completed.

In year 15 (5 sample periods), we expect to have a sufficient time series to begin the detection of trends in the composition of landbird assemblages and potentially in the densities of our species (Appendix J). As outlined in Appendix J, a mixed model approach can be used to model deterministic trends in relative abundance for a species or a suite of species. For trend detection the hypothesis of interest is for a nonzero slope of the year covariate. A mixed model analysis can accommodate additional covariate information (vegetation data) that may help explain or reduce the variability across years and among sites. In Appendix J we assumed the error distribution was Gaussian, however a Poisson distribution or negative binomial could be used for data that display inconsistencies with such an assumption via residual analysis. For those birds that are sufficiently abundant over time, geostatistical-temporal modeling (Kyriakidis and Journel 1999) will also be used to identify whether or not the spatial patterns in mean responses are changing over time (e.g., to compare “maps” of mean values developed from different field

seasons). Few trends are expected to be significant at this point in time (five data points), but it may be possible to detect trends in some of the most common species and in the landbird assemblages. In addition, one of the goals of this report is to document the methods utilized to complete this analysis with the hope of developing an automated process so the analysis can easily be repeated in future years. Once complete, this analysis will be run periodically in the future so we can continue to document in-park trends of species and landbird assemblages. One of our goals is to be able to achieve 80% power to detect a 50% decline in relative abundance of individual species. While significant trend patterns for individual species and landbird assemblages will be documented each time this analysis is completed, special care will be taken to highlight and make management aware of those individuals or assemblages that show a 50% or greater decline.

4.17 Report Format

The protocol, annual reports, and third year analysis reports will use the NPS Natural Resource Publications templates, a pre-formatted Microsoft Word template document based on current NPS formatting. The protocol will be formatted using the Natural Resource Report (NRR) template. Third year analysis and synthesis reports and other peer-reviewed technical reports that are not submitted to a journal will be formatted using the Natural Resource Technical Report (NRTR) template. Annual reports will be formatted using the Natural Resource Data Series (NRDS) template. These templates and documentation of the NPS publication standards are available at: <http://www.nature.nps.gov/publications/NRPM/index.cfm>.

5. Personnel Requirements and Training

5.1 Roles and Responsibilities

This protocol will be implemented through Cooperative Agreement H8482070095, between the Klamath Bird Observatory and the National Park Service, Klamath Network. The Klamath Bird Observatory will provide the Principal Investigator and they will work closely with the KLMN Data Manager, who will serve as the Government Technical Representative and the Network Contact. The KLMN and KBO will jointly implement this long-term monitoring program for the foreseeable future. Implementation of the Landbird Monitoring Protocol will include the following roles and responsibilities, addressed in greater detail in Appendix G.

The Principal Investigator will be responsible for supervising the Project Leads, hiring technicians and interns, conducting analyses, meeting reporting requirements, and fulfilling all requirements associated with the KBO/NPS agreement. Project Leads will be identified each year for the point count and mist netting projects.

A Project Lead for the point count surveys will coordinate implementation of annual field efforts, establish a field season schedule, assure that all equipment is available and in working order, train and supervise the VCP point count field crews, and complete data management requirements. The Project Lead for the mist net project will be responsible for operating the constant effort monitoring station at ORCA. The Project Lead will coordinate implementation of mist netting efforts, establish a field season schedule for the ORCA site, assure all equipment is available and in working order, train and supervise the mist netting field crews, and complete data management requirements associated with data collected at the constant effort monitoring station. The Project Leads will assure data quality standards are consistently met and will assure all safety considerations (Appendix K) are met.

Field interns and field technicians will be responsible for completing VCP point count surveys, mist netting, and area search surveys. They will be responsible for checking and entering monitoring data and adhering to all safety procedures.

The Network Contact is responsible for representing the KLMN in all issues related to this protocol. The Network Contact should be in constant communication with project and park staff to make certain the protocol is being properly implemented. It is the responsibility of the Network Contact to be familiar with all aspects of the protocol and provided assistance to the Network, KBO, and parks when necessary.

The KLMN Data Manager is responsible for uploading the data into the KLMN Landbird database and conducting QA/QC processes on the data. The KLMN Data Manager will ensure all products get stored in the project folder, will post information in the National I&M databases, and will manage the information on the web sites as well as manage all data submitted.

Each park within the KLMN has designated a Park Contact for the landbird project. It is the responsibility of the Network Contact or Project Lead to contact the Park Contact when necessary. Park Contacts will help support the KLMN Landbird Monitoring project, when necessary, by participating in meetings related to this project, helping with logistical planning at

their associated parks, and providing assistance with any miscellaneous tasks that might involve park staff participation.

5.2 Hiring, Qualifications, and Training

Field personnel should be in good physical condition and able to work and camp in inclement weather. Positions associated with implementing this protocol should be advertised in the Ornithological Newsletter, I&M Listserv, and other like forums no later than January 31 of each year, with employment agreements made no later than April 1 of each year. VCP point count efforts will require two field technicians, in combination, completing up to 55 days of counts. Constant-effort monitoring will require 18 days of time of the Field Lead and two interns.

5.2.1 VCP Point Count Field Technicians

Highly qualified biologists, experienced with conducting breeding bird surveys using distance estimates and proficient with identification of Klamath Region birds by sight and sound, should be hired to conduct the VCP point count surveys outlined in this protocol. Typically, they have at least 1 year of experience completing point count surveys. In addition, they must be willing to work in strenuous field conditions and camp on a regular basis. Field technicians will attend a 2-day training prior to the onset of the field season, where they will be tested for bird identification skills. In addition, training will focus on estimating distance to standing objects as well as a variety of singing species in various habitats. During this training, methodology for vegetation sampling will be reviewed and the group will practice ocular estimate methods for cover and tree height. For new field technicians and technicians that cannot pass the test associated with the 2-day training, additional training days will be completed to assure their bird identification skills and to provide more extensive vegetation survey training. The Project Lead or Field Lead will oversee all hiring. For more detailed information on qualification, hiring, and training see SOP #1: Preparation and Equipment and SOP #2: Training Observers.

5.2.2 Bird Banding Field Interns

For operation of the ORCA constant effort monitoring station, two intern students will be hired to assist the Project Lead. The Project Lead will oversee the intern hiring process (SOP #1: Preparation and Equipment). Field interns will be part of a more extensive mist netting internship program. Interns collect high quality data while gaining educational field experience. Historically, many applicants arrive to the program with general field skills and this experience provides training on specific knowledge and skills of bird monitoring. Training of field interns, supervised by the Field Lead, is rigorous and ongoing. Training follows the North American Banding Council's training guidelines (NABC 2001a, 2001b, and 2001c) and banding training (NABC 2001d). SOP #2: Training Observers provides further details about the field intern training program.

5.3 Safety

Safety of field personnel should always be the first concern in conducting a sampling program and in the selection of sampling sites. Numerous safety issues and concerns are associated with implementing a long-term, service-wide monitoring program that includes extensive fieldwork and sampling by network staff or other cooperators/contractors. Field work requires an awareness of potential hazards and knowledge of basic safety procedures. Field personnel routinely come in direct and indirect contact with rough terrain, potentially hazardous plants and

animals, and adverse weather conditions. Advanced planning can reduce or eliminate many safety hazards. Prior to going into the field, the PI should review safety procedures and job hazard analyses (Appendix K) with all field crew personnel. The Klamath Network will work to meet the goals and adhere to the beliefs of the NPS NPSafe program.

6. Operational Requirements

6.1 Annual Workload and Field Schedule

Preparation for the field season must begin well in advance of the pre-season training session. The process of recruiting and hiring qualified crew members should begin in late November or early December of the preceding year (SOP #1: Preparations and Equipment). Crew training should take place the week prior to the onset of surveys (SOP #1: Preparations and Equipment). Equipment should be inventoried, stocked, and repaired as needed prior to starting the field season (SOP #1: Preparations and Equipment and SOP #10: Post Field Season). When applicable, permits should be submitted no later than 2 months prior to conducting field work.

Sampling utilizing the mist net methodology and associated area survey methodology should take place between late May and mid-October (SOP #6: Mist Netting, SOP #7: Conducting Area Search Surveys, SOP #8: Conducting Vegetation Surveys, and SOP #9: Completing Species Checklist). Surveys using the VCP point count methodology should be implemented between early May and early July (SOP #5: Conducting Variable Circular Plot Point Count Surveys, SOP #7: Conducting Area Search Surveys, SOP #8: Conducting Vegetation Surveys, and SOP #9: Completing Species Checklist).

Data collected during the surveys should be entered on hardcopy datasheets, validated before leaving the site, and entered into the corresponding database as soon as possible (SOP #12: Data Entry). Once the data have been entered into the database, validation and verification processes should be implemented (SOP #13: Data Validation and Verification). After all attempts have been made to ensure the data are of high quality, data should be transferred to the Data Manager. In addition, analysis and report development should be completed following the instructions in SOP #17: Data Analysis and Reporting. Reports should be distributed to a broad audience following requirements outlined in SOP #16: Data Transfer, Storage, and Archiving.

In order to accomplish the variety of tasks that are associated with this protocol and to ensure products are produced in a timely fashion, it is important to recognize who is responsible for each task and what are the submission dates for products. The Narrative and associated SOPs provide details on the responsibilities of each individual associated with this protocol. In addition, Appendix G outlines the roles and responsibilities of each person working on this project. Table 1 in SOP #17: Data Transfer, Storage, and Archiving provides a list of deliverables and timelines for those deliverables and designates the primary person responsible for those products.

6.2 Facilities and Equipment Needs

This project requires minimal special facilities and equipment. The crew will require camp sites or housing in the vicinity of each park for several weeks during the point count survey season (early May- mid July) and throughout the survey season at ORCA (early May – late October). Crew members will provide their own camping gear. Computer access and personal vehicles will be provided by the field technicians and by KBO for the interns. Specialized equipment will be provided to both point count surveyors and the banding crew as detailed in SOP #1: Preparations and Equipment. If NPS facilities or equipment is required, the Project Lead should contact the Network Contact the winter before field work begins so arrangements can be made.

6.3 Budget Considerations

This project will incur relatively low startup costs beyond the present cooperative agreement between NPS and KBO. The estimated cost of fully implementing this program by KBO for 3 years (2008 - 2010) is approximately \$161, 872. The total cost of this project includes KLMN staff time (~\$9,000) and a cost-share between ORCA (\$15,000) and the KLMN (\$137,872) provided to KBO through a Cooperative Agreement (Table 4).

Table 4. A breakdown of the operational budget needed to implement the landbird monitoring protocol from 2008 through 2010.

Klamath Network Bird Monitoring Budget	Year 1	Year 2	Year 3
Administration			
Administrative Assistant Salary (1 week year 1/2, 1.5 weeks year 3)	806	806	1505
Seasonal Preparation			
<i>Banding</i>			
Project Lead Salary (0.25 month)	1003	1003	1003
<i>Point Counts</i>			
Project Lead Salary (0.25 month)	1350	1350	1350
Crew Training and Certification			
<i>Banding</i>			
Project Lead Salary (0.25 month)	1003	1003	1003
Intern Stipends	300	300	300
<i>Point Counts</i>			
Project Lead Salary (0.25 month)	1350	1350	1350
Contractor Wages (4 days)	640	640	640
Data Collection			
<i>Banding</i>			
Intern Stipends	1200	1200	1200
Housing	1000	1000	1000
Travel	3750	3750	3750
<i>Point Counts</i>			
Project Lead Salary (0.5 month)	2700	2700	2700
Contractor Wages (55 days year 1/2, 39 days year 3)	8800	8800	6240
Travel	2750	2750	1950
Data Management			
<i>Banding</i>			
Project Lead Salary (0.25 months)	1003	1003	1003
<i>Point Counts</i>			
Project Lead Salary (0.5 month)	2700	2700	2700
Data Analysis and Reporting			
Principal Investigator Salary (4 month)			31295
Project Lead Salary (0.5 month)	2700	2700	2700
KLMN Personnel			
Network Contact (GS-11, 0.5 pp)	1300	1300	1300
Data Manager (GS -11, 1.0 pp)	2600	2600	2600
KBO Subtotal	33058	33058	61691
KBO Overhead	5785	5785	10796
KLMN Subtotal	3900	3900	3900
Total Annual Budget	42743	42743	76386
Total 3-year budget			161872

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